Comparison of Ground Reaction Forces between Novice and Experienced Ballet Dancers Performing a Second Position Jump Landing

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Introduction

- Ballet dancers are exposed to the high likelihood of lower extremity injury due to repeated high-impact jumps under stringent ballet rules.[1]
- Excessive vertical ground reaction force (VGRF) and the rate of force development (RFD) during the landing phase of a jump are highly associated with the incidence of lower extremity injuries.[2]
- Experience level of the dancer may provide insight into the etiology of such injuries. However, this contention has not been formally tested.

Purpose and Hypothesis

- The purpose of this study was to compare impact VGRF and RFD during ballet second-position jump-landing tasks between novice and experienced ballet dancers.
- Hypothesis of this study was that there are differences in the rate and magnitude of the VGRF among ballet dancers with different skill levels.

Methods

Table 1. Subject Characteristics

	Novice Dancers (N = 12)	Experienced Dancers (N = 10)	*p*-value
Age (yr)	19.9 ± 1.88	18.8 ± 1.23	0.12
Height (cm)	167 ± 4.73	165 ± 7.12	0.40
Weight (N)	648 ± 97.2	557 ± 33.5	< 0.05*
Ballet experience (yr)	0.88 ± 0.23	11 ± 3.09	< 0.01*
Practice per week (hr)	2.38 ± 0.74	12 ± 4.40	< 0.01*

Methods – continued

Figure 1. Second position

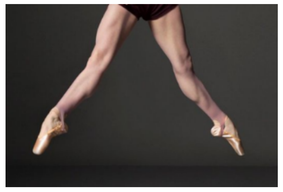

Figure 2. Second position jump

- Twelve novice ballet dancers and 10 experienced dancers performed a 10 min to warm-up before testing.
- Next, participants performed 4 consecutive second-position jumps on a force platform wearing ballet flat shoes (see Figures).

Figure 3. Experimental setup

Results

	Novcie Dancers	Experienced Dancers	P - value
Impact VGRF (N)	369 ± 96.8	150 ± 63.7	< 0.01*
Impact VGRF (BW)	0.57 ± 0.15	0.27 ± 0.10	< 0.01*
RFD (N/s)	4412 ± 1.3	1467 ± 718	< 0.01*
RFD (BW/s)	6.80 ± 1.79	2.59 ± 1.13	< 0.01*
Peak take off force (N)	946 ± 282	902 ± 255	0.71
Time in the air (s)	0.33 ± 0.03	0.35 ± 0.03	0.18
Jump height (m)	0.13 ± 0.03	0.15 ± 0.02	0.20

Results – continued

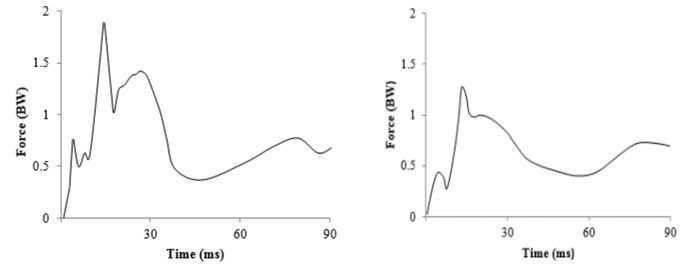

Figure 4. VGRF by one novice vs. one experienced dancer

Conclusion

- Novice ballet dancers displayed greater impact VGRF and RFD than experienced ballet dancers during the landing phase of a second-position jump. The difference in these values does not appear to be related to take off force or jump height since these values were not significantly different between the two groups.
- The difference of proficiency in ballet can be considered an influential factor for dance instructors, educators, and physicians to help dancers to reduce the likelihood of potential injuries, and for dancers themselves to execute a better jump performance.

References

1. Walter HL, Docherty CL, Schrader J. Ground Reaction Forces in Ballet Dancers Landing in Flat Shoes versus Pointe Shoes. *J Dance Med Sci*. 2011;15(2):61-64.
2. Bressel E, Cronin J. The Landing Phase of a Jump Strategies to Minimize Injuries. *J Phys Educ Recreat Dance*. 2005;76(2):30-35. doi: 10.1080/07303084.2005.10607332.